From Table 8, it can be seen that HM5.0 loop investment per line is an average of 48 percent lower than BCPM3.0's loop investment per line. This ranges from 37 percent lower in Maryland to 65 percent less in Montana.

Table 8
Loop Investment Per Line - BCPM3.0 and HM5.0
Default Results

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$922	$1,348	$767	$1,709	$5,684	$1,206
HM5.0	$515	$713	$480	$778	$2,015	$628
HM5.0/BCPM3.0	-44%	-47%	-37%	-54%	-65%	-48%

Table 9 shows that switch investment per line is an average of 54 percent lower for HM5.0, ranging from 46 percent lower in Georgia to 67 percent lower in Missouri.

Table 9
Switch Investment Per Line - BCPM3.0 and HM5.0
Default Results

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$236	$266	$250	$377	$463	$270
HM5.0	$115	$143	$121	$126	$202	$125
HM5.0/BCPM3.0	-51%	-46%	-52%	-67%	-56%	-54%

Table 10
Other Investment Per Line - BCPM3.0 and HM5.0
Default Results

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$90	$117	$81	$153	$426	$111
HM5.0	$56	$127	$58	394	$1,052	$148
HM5.0/BCPM3.0	-38%	9%	-29%	158%	147%	34%

Table 10 shows that HM5.0's other investment per line is an average of 34 percent greater than BCPM3.0's. This ranges from 38 percent lower in Florida to 158 percent greater in Missouri. Montana is also significantly higher (147 percent) for HM5.0.[29]

In summary, there are still significant differences between BCPM3.0 and HM5.0 monthly costs. These differences are due to differences in annual capital charge and expense factors, and to significant differences in network investment estimated by the models.[30] The difference in investment produced by the models indicates that the BCPM3.0 and HM5.0 platforms that produce the underlying telephone network are still very different. The difference in investments in the models is primarily the result of two factors: differences in input prices and differences in network engineering. HM5.0 results could be lower because of lower input prices or because it places less plant than BCPM.

C. Comparison of Model Results with Standardized Inputs

The comparison of BCPM3.0 and HM5.0 investment per line above is still influenced by input value assumptions, in particular structure sharing and input prices. In this section, we standardize the structure sharing assumptions between the models to produce a more uniform comparison of investment. We equalize structure sharing by assuming that the telephone company incurs 100 percent of structure costs.[31] However, due to the complexity of how input prices enter into the

[29] We discovered that HM5.0 did not compute any transport costs for 4 companies in Georgia—Camden, Ellinjay, Hawkinsville, and Interstate--and 1 company in Florida—Vista-United Telecom.

[30] As we have noted above, BCPM has not changed its capital and operating expense inputs in this version of the model. HM5.0, however, has lowered the lifetimes of its assets, resulting in a higher annual capital charge factor when compared to previous versions of HM.

[31] Because of a problem with the input macro, we were unable to change a number of the structure sharing percentages in BCPM to 100 percent. If we were able to change all structure sharing percentages, the BCPM investment numbers would be slightly higher. We also change density-related fill factors to 80 percent (for all density zones) in both models.

respective models, we do not attempt to standardize them. In addition, we standardize the major capital and operating expense factors that produce differences in monthly costs. In particular, we use the following input assumptions for both BCPM3.0 and HM5.0:

- the BCPM3.0 11.39 percent weighted cost of capital;
- FCC asset lifetimes from the BCPM3.0 "FCC scenario" with straight-line depreciation;
- Net salvage percentages from the BCPM3.0 "FCC scenario";
- and the BCPM3.0's $11.34 per line expense loading.

Table 11 compares the monthly cost per line with these standardized assumptions across the five states. On average, HM5.0 is now 16 percent lower (compared with 43 percent lower in Table 4), ranging from 13 percent lower in Maryland to 23 percent lower in Montana.

Table 11
Average Monthly Cost Per Line – BCPM3.0 and HM5.0
Standardized Inputs

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$28.61	$35.50	$26.50	$42.31	$102.21	$33.33
HM5.0	$23.68	$29.21	$22.99	$36.73	$78.52	$28.10
HM5.0/BCPM3.0	-17%	-18%	-13%	-13%	-23%	-16%

Given that monthly expenses have been equalized at $11.34 per line for the two models, the remaining differences between BCPM3.0 and HM5.0 are due to differences in investment per line and the translation of that investment into monthly capital cost per line. Table 12 shows that monthly capital costs per line are an average of 24 percent lower for HM5.0 (compared with 49 percent lower in Table 5), ranging from 18 percent lower in Missouri to 29 percent lower in Florida.

Table 12
Average Monthly Capital Costs Per Line – BCPM3.0 and HM5.0
Standardized Inputs

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$17.27	$24.16	$15.16	$30.97	$90.87	$21.99
HM5.0	$12.34	$17.87	$11.65	$25.39	$67.18	$16.76
HM5.0/BCPM3.0	-29%	-26%	-23%	-18%	-26%	-24%

Table 13 indicates that total investment per line is an average of 32 percent lower for HM5.0 when structure sharing is equalized between the two models (compared to an average of 43 percent lower in Table 7).

Table 13
Total Investment Per Line – BCPM3.0 and HM5.0
Standardized Inputs

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$1,264	$1,753	$1,113	$2,254	$6,581	$1,604
HM5.0	$821	$1,151	$793	$1,534	$4,446	$1,084
HM5.0/BCPM3.0	-35%	-34%	-29%	-32%	-32%	-32%

Table 14 indicates that loop investment per line is still an average of 34 percent lower for HM5.0 (compared to 48 percent lower in Table 8).

Table 14
Loop Investment Per Line – BCPM3.0 and HM5.0
Standardized Inputs

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$937	$1,363	$780	$1,724	$5,691	$1,220
HM5.0	$651	$881	$614	$1,015	$2,751	$800
HM5.0/BCPM3.0	-31%	-35%	-21%	-41%	-52%	-34%

Therefore, while standardizing the structure sharing assumption does bring the models somewhat closer together, there is still a significant difference in loop investment between the two models. This is due to differences in both input prices, which we have not been able to standardize, and basic loop engineering. Difference in customer location assumptions and algorithms are also a likely contributing factor, emphasizing the need for a complete evaluation and validation of customer location data and algorithms. In sum, there has not been much, if any, convergence between the models on this fundamental issue.

Table 15
Switch Investment Per Line – BCPM3.0 and HM5.0
Standardized Inputs

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$236	$272	$251	$377	$463	$272
HM5.0	$115	$143	$121	$126	$202	$125
HM5.0/BCPM3.0	-51%	-47%	-52%	-67%	-56%	-54%

Table 15 shows that switching investment remains virtually unchanged from the default runs for the models found in Table 9. Minor differences occur in a few instances because changes in fill factors have altered line counts and switch sizes. Table 16 shows that other investment remains essentially unchanged from Table 10, except for HM5.0 in Montana.

Table 16
Other Investment Per Line – BCPM3.0 and HM5.0
Standardized Inputs

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$91	$118	$82	$153	$427	$112
HM5.0	$56	$127	$58	$394	$1,493	$158
HM5.0/BCPM3.0	-39%	7%	-30%	157%	250%	42%

D. Economies of Scope

As we have noted, in its default mode, HM5.0 does not provision high-speed circuits (greater than DS-0), while BCPM3.0 does. This led us to conclude that HM5.0 does not comport with the FCC's 10 criteria in that HM5.0 does not provide the range of supported and advanced services called for in the criteria. This also has implications for network costs for the two models. The ability to offer high-speed services should convey economies of scope and lower costs per line. Therefore, another aspect of the models that we need to standardize is the presence of high-speed special circuits. To control for this, we eliminated the high-speed circuits from BCPM3.0 to make the services offered by its network more comparable to those offered by HM5.0's network.

As we demonstrate, the presence of high-speed circuits in BCPM3.0 does produce economies of scope. Therefore, eliminating high-speed circuits from BCPM3.0 results in an even greater difference in costs per line between BCPM3.0 and HM5.0.

Table 17
Average Monthly Cost Per Line - BCPM3.0 and HM5.0
Standardized Inputs, No High-Speed Circuits

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
BCPM3.0	$29.77	$37.37	$27.45	$44.99	$112.52	$35.03
HM5.0	$23.68	$29.21	$22.99	$36.73	$78.52	$28.10
HM5.0/BCPM3.0	-20%	-22%	-16%	-18%	-30%	-20%

Table 17 compares monthly costs for BCPM3.0 and HM5.0 with the standardized inputs from the previous section and with high-speed circuits eliminated from BCPM3.0. Compared to the average 16 percent lower costs for

HM5.0 from Table 11, HM5.0 costs are now 20 percent lower. Therefore, the elimination of high-speed circuits from BCPM3.0 eliminates a source of economies of scope, exacerbating the difference between BCPM3.0 and HM5.0.

The increased difference between BCPM3.0 and HM5.0 when high-speed circuits are eliminated is due to increases in loop investment per line and other investment per line in BCPM3.0. Table 18 shows that BCPM3.0 total investment per line increases by an average of 7 percent when high-speed circuits are eliminated.

Table 18
Comparison of BCPM3.0 Total Investment Per Line
With and Without High-Speed Circuits

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
(1) Without High-Speed	$1,348	$1,883	$1,181	$2,440	$7,283	$1,723
(2) With High-Speed	$1,264	$1,753	$1,113	$2,254	$6,581	$1,604
(1)/(2)	7%	7%	6%	8%	11%	7%

This is due to an average 9 percent increase in loop investment per line (Table 19) and an average 5 percent increase in other investment per line (Table 20). There is no difference in switch investment per line when high-speed circuits are eliminated.

Table 19
Comparison of BCPM3.0 Loop Investment Per Line
With and Without High-Speed Circuits

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
(1) Without High-Speed	$1,017	$1,487	$845	$1,901	$6,358	$1,334
(2) With High-Speed	$937	$1,363	$780	$1,724	$5,691	$1,220
(1)/(2)	9%	9%	8%	10%	12%	9%

Table 20
Comparison of BCPM3.0 Other Investment Per Line
With and Without High-Speed Circuits

	Florida	Georgia	Maryland	Missouri	Montana	Wtd Avg
(1) Without High-Speed	$95	$125	$86	$163	$462	$118
(2) With High-Speed	$91	$118	$82	$153	$427	$112
(1)/(2)	5%	6%	4%	6%	8%	5%

IV. General comments on model operation

In addition to addressing the FCC's 10 criteria, we believe it is important to also report on our overall experience in running the current versions of the proxy models. We comment here on model installation and setup, user interface, and model execution and outputs.

A. Installation and Setup

Both BCPM3.0 and HM5.0 were more difficult to install than their predecessors. The BCPM3.0 installation requires over 600 megabytes of disk space, most of which is required for state-specific files. An option to install only selected states would be useful. Initially, neither BCPM3.0 nor HM5.0 would run due to software conflicts. Performing "clean" installations of the Microsoft Office 97 software, then re-installing the models solved the problems. Both models appear to be overly sensitive to the presence of other Visual Basic software. The HCPM installation procedure involved downloading or copying compressed files containing the model and data for individual states. It is easy to selectively install states in HCPM. However, none of the input files to the CENBLOCK module were provided in the HCPM2.0 release, so it was not possible to run the customer location program.

B. User Interface

The HM5.0 user interface is essentially the same as HM3.0. HM's system of dialog boxes make it relatively easy to change parameter values for individual scenarios. However, applying a large number of parameter changes to multiple states through the user interface is tedious. Editing the Microsoft Access database that contains the HM5.0 scenario parameter values is relatively straightforward.

BCPM3.0 employs a significantly revised user interface relative to BCPM1.1. We encountered major problems with the macros that update BCPM user parameter values. BCPM3.0 uses a spreadsheet as the front-end to the process whereby text files with scenario-specific inputs are changed. An error in the macro that updates the text files prevented us from saving parameter changes through the user interface. Editing the text files, which are in comma-separated format, is difficult because they use vertical bars in addition to commas to delimit some input values. While investigating this problem, we also discovered that certain structure investment inputs cannot be changed through the user interface. Overall, the inputs section of the BCPM user interface appears to have been inadequately tested and debugged.

HCPM has no user interface. The text files containing user-adjustable inputs must be manipulated directly to alter parameter values. The model is run from the command line. Analyzing and using HCPM requires a great degree of programming sophistication. This limits the ability to review the model and, thus, appears to be contrary to the FCC's position that proxy models must be presented in a manner that facilitates public evaluation.

C. Model execution and outputs

BCPM3.0 processes data at the state level. It is easy to run multiple states consecutively via the user interface. HM5.0 processing is at the company level. HM5.0 provides multiple company scenarios which process companies in batches. Model run times are longer than in previous versions, largely due to the more detailed customer location data provided with the models. Neither model tolerates interruption by other Windows system events, such as the Windows screen saver. In such cases, BCPM3.0 tends to halt outright; and HM5.0 output may be corrupted under such circumstances. BCPM3.0 report generation requires an additional, relatively time-consuming, processing step.

Once processed, BCPM3.0 offers significantly more flexible reporting capabilities than HM5.0. For instance, the "summary" and "detail" reports can be produced for companies, groups of companies, or states using the user interface. HM5.0 has a limited capability to summarize its monthly cost and universal service support results, but to summarize other HM5.0 results (such as investment amounts) requires extensive spreadsheet programming.

V. Conclusion

Our analysis has focused primarily on the BCPM3.0 and HM5.0 platforms. Because of the incomplete status of HCPM, it was not possible to evaluate the FCC Staff's model with respect to the FCC's 10 criteria. Currently, HCPM only models loop investment and does not model other network elements. In addition, HCPM does not currently have a capital cost or expense module, meaning that HCPM investments cannot be translated into monthly costs. The incomplete nature of the HCPM leads to the obvious conclusion that the model does not meet the FCC's 10 criteria at this time.

At this point in time, neither BCPM3.0 nor HM5.0 fully satisfies the FCC's 10 criteria. In terms of model platforms, BCPM3.0 appears to be more consistent with the FCC's criteria at this point in time.

A key area that remains unresolved is customer location. Both BCPM3.0 and HM5.0 have improved their customer location algorithms from previous versions of the models. However, because both BCPM3.0 and HM5.0 do a substantial amount of exogenous processing and not all customer location data is readily verifiable, the accuracy of each model's customer location modules is difficult to assess at this time. In this respect the HCPM has an advantage because all of the source code for its customer location module is available for inspection. Complete access to customer location data and algorithms is necessary to determine the accuracy of HM5.0's geocoding and customer location assumptions, and BCPM3.0's customer location sources and algorithms. However, it must be asked whether any proxy model, regardless of how sophisticated its algorithms and assumptions, will ever be able to satisfactorily locate customers and engineer the appropriate network under all circumstances.

Even after standardizing a number of key inputs, the results of BCPM3.0 and HM5.0 are still far apart. For example, after standardizing structure sharing assumptions, there is still a significant difference in loop investment between the two models. This is due to differences in both input prices, which have not been standardized in this analysis, basic loop engineering, and customer location methods. Thus, it appears that there has not been much, if any, convergence between the models on this fundamental issue.

Finally, it must be kept in mind that proxy models are not likely to accurately estimate the forward-looking cost levels of an efficient actual market participant. First, as we noted in Section I, the scorched node approach used by the proxy models produces the costs of a hypothetical market participant and is not likely to accurately reflect the forward-looking costs of an actual market participant. Second, given this qualification, proxy models are inherently limited in their ability to determine optimal solutions because of their general nature and their reliance on publicly available data. This is a limitation of all proxy models and not a shortfall of any particular model. Given this inherent limitation, proxy models are not suited to accurately reflect the forward-looking costs of actual market participants. The most that should be asked of proxy models is to reflect relative cost relationships for the purpose of identifying high-cost areas. However, even in this regard, the models are still in need of improvement.

Attachment A

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